CLAIMS

1. A tint additive capable of providing tintability to a coating composition, the tint additive represented by the formula:

$$R_1\text{-}(OCH_2CH_2)_n\text{-}O\text{-}R_2$$

wherein at least one of R_1 and R_2 is silane containing group represented by the formula:

where R_3 is H, an alkyl group containing from about 1 to about 5 carbon atoms, or an acetyl group, and where R_4 is H, an epoxy functional group, an alkyl group, a functional alkyl group, an alkylene group, an aryl group, an alkyl ether, or combinations thereof containing from about 1 to about 10 carbon atoms, where X is an integer from 0 to about 3 and n is a positive integer, and where only one of R_1 or R_2 is the silane containing group, R_1 or R_2 is H.

2. A coating composition that is capable of being tinted after application to a substrate, comprising:

a tint additive represented by the formula:

$$R_1\text{-}(OCH_2CH_2)_n\text{-}O\text{-}R_2$$

wherein at least one of R_1 and R_2 is silane containing group represented by the formula:

where R_3 is H, an alkyl group containing from about 1 to about 5 carbon atoms, or an acetyl group, and where R_4 is H, an epoxy functional group, an alkyl group, a functional alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from about 1 to about 10 carbon atoms, where X is an integer from 0 to about 3 and n is a positive integer, and where only one of R_1 or R_2 is the silane containing group, R_1 or R_2 is H; and

a base compound selected from the group consisting of:

(1) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane and a

tetrafunctional silane and from about 0.1 to about 30 weight percent, based on the total solids of the composition, of a multifunctional compound, selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof, the epoxy functional silane and the tetrafunctional silane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.1:1 to about 5:1, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof equivalent to from about 0.1 to about 50 weight percent solids, based on the total solids of the composition;

(2) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, a disilane, and from about 0.01 to about 80 weight percent, based on the total weight of the composition, of a

carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, the epoxy functional silane and the disilane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.05:1 to about 5:1, the coating compositions may further include from about 0.1 to about 80 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof, equivalent to from about 0.1 to about 75 weight percent solids, based on the total solids of the composition;

(3) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total solids of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and

combinations thereof, from about 1 to 90 weight percent, based on the total weight of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a colloidal silica material, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition;

(4) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total solids of the composition, of a metal oxide composite colloid, from about 1 to 75 weight percent, based on the total solids of the composition, of a

colloidal silica material, and from about 1 to 75 weight percent, based on the total solids of the composition, of a tetrafunctional silane;

(5) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total solids of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a disilane; and

(6) combinations thereof.

3. The composition of claim 2 wherein the hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane are present in the aqueous-organic solvent

mixture in an amount of from about 10 to about 99.9 weight percent, based on the total solids of the coating composition and wherein the multifunctional compound is present in the aqueous-organic solvent mixture in an amount of from about 0.1 to about 30 weight percent, based on the total solids of the coating composition.

4. The composition of claim 2 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of an alcohol, an ether, a glycol, a glycol ether, an ester, a ketone, a glycolether acetate and mixtures thereof.

5. The composition of claim 2 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

6. The composition of claim 2 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the formula R^1-$(OR^2)_x$-OR^1 where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10 carbon atoms and R^2

is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

7. The composition of claim 2 wherein the epoxy functional silane is present in a molar ratio to the tetrafunctional silane of from about 0.1:1 to about 3:1.

8. The composition of claim 2 wherein the epoxy functional silane is represented by the formula $R^3_xSi(OR^4)_{4-x}$ where x is an integer of 1, 2 or 3, R^3 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from 1 to about 10 carbon atoms and having at least 1 epoxy functional group, and R^4 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, a $-Si(OR^5)_{3-y}R^6_y$ group where y is an integer of 0, 1, 2, or 3, and combinations thereof where R^5 is H, an alkyl group containing from 1 to about 5 carbon atoms an acetyl group, another $-Si(OR^5)_{3-y}R^6_y$ group and combinations thereof, and R^6 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms.

9. The composition of claim 8 wherein the tetrafunctional silane is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group

containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a $-Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another $-Si(OR^8)_3$ group and combinations thereof.

10. The composition of claim 2 wherein the hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane are present in the aqueous-organic solvent mixture in an amount of from about 10 to about 99.9 weight percent, based on the total solids of the coating composition and wherein the multifunctional compound is present in the aqueous-organic solvent mixture in an amount of from about 0.1 to about 30 weight percent, based on the total solids of the coating composition and wherein the epoxy functional silane is represented by the formula $R^3_xSi(OR^4)_{4-x}$ where x is an integer of 1, 2 or 3, R^3 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from 1 to about 10 carbon atoms and having at least 1 epoxy functional group, and R^4 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, a $-Si(OR^5)_{3-y}R^6_y$ group where y is an integer of 0, 1, 2, or 3, and combinations thereof where R^5 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, or another $-Si(OR^5)_{3-}$

$_yR^6{}_y$ group and combinations thereof, and R^6 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from 1 to about 10 carbon atoms.

11. The composition of claim 10 wherein the tetrafunctional silane is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a $-Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another $-Si(OR^8)_3$ group and combinations thereof.

12. The composition of claim 11 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

13. The composition of claim 11 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the formula R^1-$(OR^2)_x$-OR^1 where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10 carbon

atoms and R^2 is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

14. The composition of claim 11 wherein the amount of water present in the aqueous-organic solvent mixture is an amount sufficient to provide a substantially homogeneous mixture of hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane.

15. The composition of claim 2 wherein the tetrafunctional silane is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a $-Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another $-Si(OR^8)_3$ group and combinations thereof.

16. The composition of claim 2 wherein at least a portion of the solvent component of the aqueous-organic solvent mixture is generated during hydrolysis of the epoxy functional silane and the tetrafunctional silane.

17. The composition of claim 2 further comprising an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

18. The composition of claim 17 wherein the effective amount of the catalyst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

19. The composition of claim 18 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_xSi(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

20. The composition of claim 19 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

21. The composition of claim 2 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_xSi(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

22. The composition of claim 21 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide

substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

23. The composition of claim 2 wherein the aqueous-organic solvent mixture further comprises:

from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_xSi(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof; and

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

24. The composition of claim 20 further comprising an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

25. The composition of claim 23 wherein the effective amount of the catalyst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

26. The composition of claim 23 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

27. The composition of claim 2 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

28. The composition of claim 27 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

29. The composition of claim 28 wherein the aqueous-organic solvent mixture further comprises an effective amount of a catalyst to provide enhanced abrasion resistance to the coating produced by curing the aqueous solvent mixture.

30. The composition of claim 29 wherein the effective amount of catalyst present in the aqueous-organic solvent mixture is from about 0.1 to about 10 weight percent, based on the total solids of the aqueous-organic solvent mixture.

31. The composition of claim 29 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total of solids of the aqueous-organic solvent mixture, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_xSi(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

32. The composition of claim 2 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

33. A process for providing a substantially transparent, abrasion resistant coating capable of being tinted on a substrate, comprising the steps of:

applying to at least one surface of a substrate an effective amount of an aqueous-organic solvent mixture comprising:

hydrolysis products and partial condensates of an epoxy functional silane, a tetrafunctional silane and a multifunctional compound wherein the

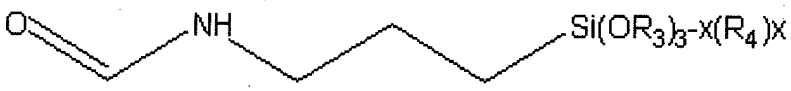
multifunctional compound is selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof and wherein the epoxy functional silane is present in a molar ratio to the tetrafunctional silane of from about 0.1:1 to about 5:1,

an amount of water sufficient to hydrolyze the epoxy functional silane and the tetrafunctional silane, and

a tint additive represented by the formula:

$$R_1\text{-}(OCH_2CH_2)_n\text{-}O\text{-}R_2$$

wherein at least one of R_1 and R_2 is represented by the formula



where R_3 is H, an alkyl group containing from about 1 to about 5 carbon atoms, or an acetyl group, and where R_4 is H, an epoxy functional group, an alkyl group, a functional alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from about 1 to about 10 carbon atoms, and where X is an integer from 0 to about 3

and n is a positive integer, and where only one of R_1 or R_2 is the silane containing group, R_1 or R_2 is H; and

a base compound selected from the group consisting of:

(1) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane and a tetrafunctional silane and from about 0.1 to about 30 weight percent, based on the total solids of the composition, of a multifunctional compound, selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof, the epoxy functional silane and the tetrafunctional silane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.1:1 to about 5:1, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof

equivalent to from about 0.1 to about 50 weight percent solids, based on the total solids of the composition;

(2) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, a disilane, and from about 0.01 to about 80 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, the epoxy functional silane and the disilane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.05:1 to about 5:1, the coating compositions may further include from about 0.1 to about 80 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof, equivalent to from about 0.1 to about 75 weight percent solids, based on the total solids of the composition;

(3) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total solids of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total weight of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a colloidal silica material, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition;

(4) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and

partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total solids of the composition, of a metal oxide composite colloid, from about 1 to 75 weight percent, based on the total solids of the composition, of a colloidal silica material, and from about 1 to 75 weight percent, based on the total solids of the composition, of a tetrafunctional silane;

(5) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent,

based on the total solids of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a disilane; and

(6) combinations thereof; and

curing the coating composition to produce a substantially transparent, abrasion resistant coating capable of being tinted on the substrate.

34. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane are present in the aqueous-organic solvent mixture in an amount of from about 10 to about 99.9 weight percent, based on the total solids of the coating composition and wherein the multifunctional compound is present in the aqueous-organic solvent mixture in an amount of from about 0.1 to about 30 weight percent, based on the total solids of the coating composition.

35. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol

having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

36. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the formula R^1 --$(OR^2)_x$ --OR^1 where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10 carbon atoms and R^2 is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

37. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the epoxy functional silane is present in the aqueous-organic solvent mixture in a molar ratio to the tetrafunctional silane of from about 0.1:1 to about 3:1.

38. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the epoxy functional silane present in the aqueous-organic mixture is represented by the formula $R^3_x Si(OR^4)_{4-x}$ where x is an integer of 1, 2

or 3, R^3 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms and having at least 1 epoxy functional group, and R^4 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, a $--Si(OR^5)_{3-y}\ R^6{}_y$ group where y is an integer of 0, 1, 2, or 3, and combinations thereof where R^5 is H, an alkyl group containing from 1 to about 5 carbon atoms an acetyl group, another $--Si(OR^5)_{3-y}\ R^6{}_y$ group and combinations thereof, and R^6 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms.

39. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 38 wherein the tetrafunctional silane present in the aqueous-organic mixture is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a $--Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another $--Si(OR^8)_3$ group and combinations thereof.

40. The process for providing a substantially transparent, abrasion

resistant coating on a substrate of claim 33 wherein the hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane are present in the aqueous-organic solvent mixture in an amount of from about 10 to about 99.9 weight percent, based on the total solids of the coating composition and wherein the multifunctional compound is present in the aqueous-organic solvent mixture in an amount of from about 0.1 to about 30 weight percent, based on the total solids of the coating composition and wherein the epoxy functional silane is represented by the formula R^3_x $Si(OR^4)_{4-x}$ where x is an integer of 1, 2 or 3, R^3 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms and having at least 1 epoxy functional group, and R^4 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, a $--Si(OR^5)_{3-y}$ R^6_y group where y is an integer of 0, 1, 2, or 3, and combinations thereof where R^5 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, another $--Si(OR^5)_{3-y}$ R^6_y group and combinations thereof, and R^6 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms.

41. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 40 wherein the tetrafunctional silane present in the aqueous-organic mixture is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a --$Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another --$Si(OR^8)_3$ group and combinations thereof.

42. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 41 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

43. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 41 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the formula R^1 --$(OR^2)_x$ --OR^1 where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10

carbon atoms and R.sup.2 is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

44. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 41 wherein the amount of water present in the aqueous-organic solvent dispersion is an amount sufficient to provide a substantially homogeneous mixture of hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane.

45. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the tetrafunctional silane present in the aqueous-organic solvent mixture is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a --$Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another --$Si(OR^8)_3$ group and combinations thereof.

46. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein at least a portion of the solvent component of the aqueous-organic solvent mixture is

generated during hydrolysis of the epoxy functional silane and the tetrafunctional silane.

47. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the aqueous-organic solvent mixture further comprises an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

48. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 47 wherein the effective amount of the catalyst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

49. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 48 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

50. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 49 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

51. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

52. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 51 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

53. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the aqueous-organic solvent mixture further comprises:

from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis

products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof; and

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

54. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 53 wherein the aqueous-organic solvent mixture further comprises an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

55. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 54 wherein the effective

amount of the catalyst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

56. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 54 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

57. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

58. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 57 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

59. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 58 wherein the amount of water present in the aqueous-organic solvent mixture is an amount sufficient to provide a substantially homogeneous mixture of hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane.

60. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 59 wherein the aqueous-organic solvent mixture further comprises an effective amount of a catalyst to provide enhanced abrasion resistance to the coating produced by curing the aqueous-organic solvent mixture.

61. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 60 wherein the effective amount of catalyst present in the aqueous-organic solvent mixture is

from about 0.1 to about 10 weight percent, based on the total solids of the aqueous-organic solvent mixture.

62. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 60 wherein the aqueous-organic solvent mixture further comprises from about 0.1 to about 50 weight percent, based on the total of solids of the aqueous-organic solvent mixture, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

63. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the aqueous-organic solvent mixture further comprises:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide

substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

64. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the substrate is formed of plastic, wood, ceramic, glass ceramic, glass, mineral based, leather, paper, textile and metal materials.

65. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 further comprising:

treating the substrate to enhance adhesion of the substantially transparent, abrasion resistant coating to the substrate.

66. The process for providing a substantially transparent, abrasion resistant coating on a substrate of claim 33 wherein the curing of the aqueous-organic solvent mixture coating to produce a substantially transparent, abrasion-resistant coating on the substrate is achieved by heating the substrate having the aqueous-organic solvent mixture coating applied thereto to a temperature of from about 50.degree. C. to about 200.degree. C. for a period of time effective to cure the coating and provide the substrate with a substantially transparent,

substantially uniform abrasion resistant coating having a Bayer number of at least 5.

67. An article comprising:

a substrate; and

a coating composition formed on at least one surface of the substrate, the coating formed by curing an aqueous-organic solvent mixture applied to the at least one surface of the substrate, wherein the aqueous-organic solvent mixture comprises:

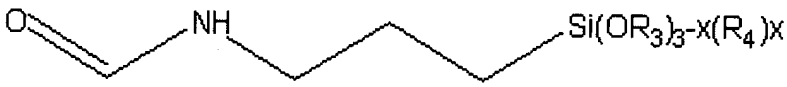
hydrolysis products and partial condensates of an epoxy functional silane, a tetrafunctional silane and a multifunctional compound wherein the multifunctional compound is selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof and wherein the epoxy functional silane is present in a molar ratio to the tetrafunctional silane of from about 0.1:1 to about 5:1;

an amount of water sufficient to hydrolyze the epoxy functional silane and the tetrafunctional silane; and

a tint additive represented by the formula:

$$R_1\text{-}(OCH_2CH_2)_n\text{-}O\text{-}R_2$$

wherein at least one of R_1 and R_2 is represented by the formula



where R_3 is H, an alkyl group containing from about 1 to about 5 carbon atoms, or an acetyl group, and where R_4 is H, an epoxy functional group, an alkyl group, a functional alkyl group, an alkylene group, an aryl group, an alkyl ether, and combinations thereof containing from about 1 to about 10 carbon atoms, and where X is an integer from 0 to about 3 and n is a positive integer, and where only one of R_1 or R_2 is the silane containing group, R_1 or R_2 is H; and

a base compound selected from the group consisting of:

(1) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane and a

tetrafunctional silane and from about 0.1 to about 30 weight percent, based on the total solids of the composition, of a multifunctional compound, selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof, the epoxy functional silane and the tetrafunctional silane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.1:1 to about 5:1, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof equivalent to from about 0.1 to about 50 weight percent solids, based on the total solids of the composition;

(2) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 99.9 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, a disilane, and from about 0.01 to about 80 weight percent, based on the total weight of the composition, of a

carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, the epoxy functional silane and the disilane are present in the aqueous organic solvent mixture in a molar ratio of from about 0.05:1 to about 5:1, the coating compositions may further include from about 0.1 to about 80 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition, and/or an amount of colloidal silica or a metal oxide or combinations thereof, equivalent to from about 0.1 to about 75 weight percent solids, based on the total solids of the composition;

(3) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total solids of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and

combinations thereof, from about 1 to 90 weight percent, based on the total weight of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a colloidal silica material, the coating compositions may further include from about 0.1 to about 50 weight percent of a mixture of hydrolysis products and partial condensates of one or more silane additives, based on the total solids of the composition;

(4) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total solids of the composition, of a metal oxide composite colloid, from about 1 to 75 weight percent, based on the total solids of the composition, of a

colloidal silica material, and from about 1 to 75 weight percent, based on the total solids of the composition, of a tetrafunctional silane;

(5) coating compositions which comprise an aqueous organic solvent mixture containing from about 10 to about 90 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of an epoxy functional silane, from about 1 to about 90 weight percent, based on the total weight of the composition, of a carboxylic acid functional compound selected from the group consisting of carboxylic acids, multifunctional carboxylic acids, anhydrides, and combinations thereof, from about 1 to 90 weight percent, based on the total solids of the composition, of a metal oxide composite colloid, and from about 1 to 75 weight percent, based on the total solids of the composition, of a disilane; and

(6) combinations thereof.

68. The article of claim 67 wherein the epoxy functional silane is present in a molar ratio to the tetrafunctional silane of from about 0.1:1 to about 3:1.

69. The article of claim 67 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of an alcohol, an ether, a glycol, a glycol ether, an ester, a ketone, a glycolether acetate and mixtures thereof.

70. The article of claim 69 wherein the aqueous-organic solvent mixture further includes an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

71. The article of claim 70 wherein the effective amount of the cataylst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

72. The article of claim 71 wherein the aqueous-organic solvent mixture further includes from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

73. The article of claim 72 wherein the aqueous-organic solvent mixture further includes:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

74. The article of claim 67 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

75. The article of claim 67 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the

formula R^1 --$(OR^2)_x$ --OR.sup.1 where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10 carbon atoms and R^2 is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

76. The article of claim 67 wherein the epoxy functional silane is represented by the formula R^3_x $Si(OR^4)_{4-x}$ where x is an integer of 1, 2 or 3, R^3 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms and having at least 1 epoxy functional group, and R^4 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, a --$Si(OR^5)_{3-y}$ R^6_y group where y is an integer of 0, 1, 2, or 3, and combinations thereof where R^5 is H, an alkyl group containing from 1 to about 5 carbon atoms, an acetyl group, another --$Si(OR^5)_{3-y}$ R^6 group and combinations thereof, and R^6 is H, an alkyl group, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether and combinations thereof containing from 1 to about 10 carbon atoms.

77. The article of claim 76 wherein the tetrafunctional silane is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an

(OR^7) carboxylate, a $--Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another $--Si(OR^8)_3$ group and combinations thereof.

78. The article of claim 77 wherein the solvent constituent of the aqueous-organic solvent mixture is an alcohol having the general formula ROH where R is an alkyl group containing from 1 to about 10 carbon atoms.

79. The article of claim 77 wherein the solvent constituent of the aqueous-organic solvent mixture is selected from the group consisting of a glycol, an ether, a glycol ether and mixtures thereof having the formula $R^1 --(OR^2)_x --OR^1$ where x is an integer of 0, 1, 2, 3 or 4, R^1 is H or an alkyl group containing from 1 to about 10 carbon atoms and R^2 is an alkylene group containing from 1 to about 10 carbon atoms and combinations thereof.

80. The article of claim 77 wherein the amount of water present in the aqueous-organic solvent dispersion is an amount sufficient to provide a substantially homogeneous mixture of hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane.

81. The article of claim 67 wherein the tetrafunctional silane is represented by the formula $Si(OR^7)_4$ where R^7 is H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^7) carboxylate, a --$Si(OR^8)_3$ group where R^8 is a H, an alkyl group containing from 1 to about 5 carbon atoms and ethers thereof, an (OR^8) carboxylate, another --$Si(OR^8)_3$ group and combinations thereof.

82. The article of claim 67 wherein at least a portion of the solvent component of the aqueous-organic solvent mixture is generated during hydrolysis of the epoxy functional silane and the tetrafunctional silane.

83. The article of claim 67 wherein the aqueous-organic solvent mixture further includes: from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an

alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing form 1 to about 10 carbon atoms, an acetyl group and combinations thereof.

84. The article of claim 83 wherein the aqueous-organic solvent mixture further includes:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

85. The article of claim 67 wherein the aqueous-organic solvent mixture further includes:

from about 0.1 to about 50 weight percent, based on the total solids of the composition, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a

functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations thereof, R^{10} is H, an alkyl group containing from 1 to about 10 carbon atoms, an acetyl group and combinations thereof; and

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

86. The article of claim 85 wherein the aqueous-organic solvent mixture further includes an effective amount of a catalyst to provide enhanced abrasion resistance to a coating produced by curing the composition.

87. The article of claim 86 wherein the effective amount of the catalyst is from about 0.1 to about 10 weight percent, based on the total solids of the composition.

88. The article of claim 87 wherein the aqueous-organic solvent mixture further includes:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide

substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

89. The article of claim 67 wherein the aqueous-organic solvent mixture further includes:

an effective amount of colloidal silica to provide the composition with from about 0.1 to about 50 weight percent silica, based on the total of solids present in the composition.

90. The article of claim 89 wherein the aqueous-organic solvent mixture further includes:

an effective amount of a leveling agent to spread the aqueous-organic solvent mixture on the substrate and provide substantially uniform contact of the aqueous-organic solvent mixture with the substrate.

91. The article of claim 90 wherein the amount of water present in the aqueous-organic solvent mixture is an amount sufficient to provide a substantially homogeneous mixture of hydrolysis products and partial condensates of the epoxy functional silane and the tetrafunctional silane.

92. The article of claim 91 wherein the aqueous-organic solvent mixture further includes an effective amount of a catalyst to provide enhanced abrasion resistance to the coating produced by curing the aqueous solvent mixture.

93. The article of claim 92 wherein the effective amount of catalyst present in the aqueous-organic solvent mixture is from about 0.1 to about 10 weight percent, based on the total solids of the aqueous-organic solvent mixture.

94. The article of claim 92 wherein the aqueous-organic solvent mixture further includes from about 0.1 to about 50 weight percent, based on the total of solids of the aqueous-organic solvent mixture, of a mixture of hydrolysis products and partial condensates of a silane additive represented by the formula

$$R^9_x\ Si(OR^{10})_{4-x}$$

where x is an integer of 1, 2 or 3, R^9 is H, an alkyl group containing from 1 to about 10 carbon atoms, a functionalized alkyl group, an alkylene group, an aryl group, an alkyl ether group and combinations